

**SMALL ON-BOARD ENVIRONMENTAL DIAGNOSTIC SENSORS
PACKAGE (SOBEDS)**

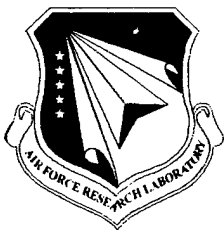
**Robert H. Redus
Alan C. Huber
John O. McGarity
John A. Pantazis**

**AMPTEK, INC.
6 DeAngelo Drive
Bedford, MA 01730-2204**

16 December 2002

Scientific Report No. 6

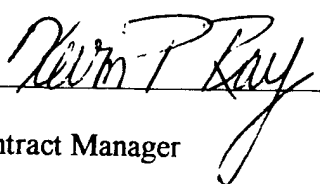
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

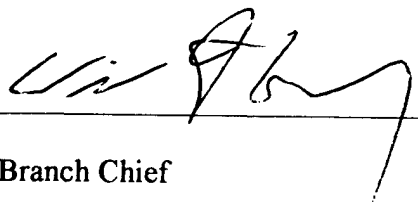


**AIR FORCE RESEARCH LABORATORY
Space Vehicles Directorate
29 Randolph Rd
AIR FORCE MATERIEL COMMAND
Hanscom AFB, MA 01731-3010**

20030822 104

This technical report has been reviewed and is approved for publication.


Contract Manager


Branch Chief

* (This report has been reviewed by the ESC Public Affairs Office (ESC/PAM) and is releasable to the National Technical Information Service (NTIS).)

Qualified requestors may obtain additional copies from the Defense Technical Information Center (DTIC). * (All others should apply to the NTIS.)

If your address has changed, or if you wish to be removed from the mailing list, or if the addressee is no longer employed by you, please notify AFRL/VSIM, 29 Randolph Road, Hanscom AFB, MA 01731-3010. This will help us to maintain a current mailing list.

DO NOT RETURN COPIES OF THIS REPORT unless contractual obligations or notices on a specific document require that it be returned.

* ON RESTRICTED REPORTS (CLASSIFIED/STATEMENT B) THOSE STATEMENTS IN PARENTHESIS ABOVE ARE REMOVED FROM THIS SIGNATURE PAGE

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 12-16-2002	3. REPORT TYPE AND DATES COVERED Annual 10/1/00 - 10/1/01		
4. TITLE AND SUBTITLE Small On-Board Environmental Diagnostic Sensor Package (SOBEDS)		5. FUNDING NUMBERS Contract Number: F19628-95-C-0227 Program Element Number: 63401F Project Number: 2822 Task Number: GC Work unit Number: AM		
6. AUTHOR(S) Robert Redus, John O. McGarity, Alan C. Huber, John A. Pantazis				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Amptek Inc. 6 DeAngelo Drive Bedford, MA. 01730		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory 29 Randolph Rd. Hanscom AFB, MA 01731-3010 Contract Manager: Kevin Ray/VSBXR (781-377-3828)		10. SPONSORING/MONITORING AGENCY REPORT NUMBER AFRL-VS-TR-2003-1503		
11. SUPPLEMENTARY NOTES A contract extension, with additional funding, makes the previous Final Report Scientific Report No. 5 for this contract.				
12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for public Release; Distribution unlimited.		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) This report contains the summary of the scientific and engineering work performed during the most recent year as part of the development of the High Energy Proton instrument (HEP) and of the Low Energy Particle and Dosimetry instrument (LEPDOS). These instruments are part of the SOBEDS suite of instruments being developed by Amptek, Inc. The purpose of the HEP instrument is to measure the energy spectrum of energetic protons, specifically to obtain a differential spectrum for $25 < E < 440$ MeV and integral counts for $E > 440$ MeV. The purpose of the LEPDOS instrument is to measure: 1) the lower energy protons and electrons that may cause spacecraft anomalies, specifically protons from 0.7 to 80 MeV and electrons from 5 to > 250 keV, 2) the dose and dose rate experienced by spacecraft electronics, 3) particles causing single event effects, and 4) to provide real-time warnings to spacecraft and operators of environmental conditions likely to cause anomalies, such as surface charging and deep dielectric charging.				
14. SUBJECT TERMS High energy proton, Low energy particle, Dosimetry, ESA, LEPDOS, HEP			15. NUMBER OF PAGES	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT U	18. SECURITY CLASSIFICATION OF THIS PAGE U	19. SECURITY CLASSIFICATION OF ABSTRACT U	20. LIMITATION OF ABSTRACT UU	

1. Introduction

This report contains the summary of the scientific and engineering work performed during the most recent year as part of the development of the High Energy Proton instrument (HEP) and of the Low Energy Particle and Dosimetry instrument (LEPDOS). These instruments are part of the SOBEDS suite of instruments being developed by Amptek, Inc. The purpose of the HEP instrument is to measure the energy spectrum of energetic protons, specifically to obtain a differential spectrum for $25 \leq E \leq 440$ MeV and integral counts for $E > 440$ MeV. The purpose of the LEPDOS instrument is to measure: 1) the lower energy protons and electrons that may cause spacecraft anomalies, specifically protons from 0.7 to 80 MeV and electrons from 5 to >250 keV, 2) the dose and dose rate experienced by spacecraft electronics, 3) particles causing single event effects, and 4) to provide real-time warnings to spacecraft and operators of environmental conditions likely to cause anomalies, such as surface charging and deep dielectric charging.

The first five years of this contract effort included the research, development, and fabrication of three flight LEPDOS units, including one with an ESA (electrostatic analyzer), and a flight HEP unit. At the conclusion of this five year effort, the instruments were as complete as possible, without specifying a spacecraft interface¹. The second five year portion of the contract is to cover spacecraft specific engineering efforts, spacecraft integration, and initial flight support. This effort cannot proceed until specific spacecraft are chosen by the AFRL/VSBS contract monitor and the contract monitor tasks Amptek to carry out the spacecraft specific work.

2. High Energy Proton Telescope (HEP)

The HEP instrument consists of two separate packages, a sensor head and an electronics box. Both the flight sensor head and an engineering model sensor head were completed during the initial effort. They are fully completed, including the sensors themselves, the electronics, and the package. The electronics box consists of five major electronic sub-assemblies: an analog board, a DSP board, a CPU board, an I/O board, and a power supply board. Flight analog, DSP, and CPU boards have been completed. The onboard software, I/O board, and Power board are all spacecraft specific. Therefore, they are in protoflight configuration, pending specification of the spacecraft interface. HEP is in storage in Amptek's vault, pending assignment of a spacecraft.

During the most recent year, we received the flight D4 detector for HEP. The previously ordered detector did not meet the manufacturer's specifications, so a replacement detector had been ordered. It was received, underwent bench testing to verify compliance with the manufacturer's specifications, and installed into the HEP flight sensor head. A preliminary test of the reassembled sensor head was completed. In addition, we received comments from the referees regarding a research paper which was submitted to the journal "Nuclear Instruments and Methods in Scientific Research" and the paper was revised accordingly.

3. Low Energy Particle and Dosimetry Instrument (LEPDOS)

Three flight LEPDOS instruments were developed during the initial phase of this contract. They included two "standard" instruments, designated S/N 004 and 005, and one with an ESA, designated S/N 007. The unit with the ESA, S/N 007, was launched on 6 Aug 2001 into geosynchronous orbit aboard a DSP spacecraft. We provided support for on-orbit checkout, verifying the initial flight data which was provided to us. The overall instrument operation appears good, and in particular the ESA which is new for this unit is working extremely well.

The other two units, S/N 004 and 005, have been completed and are now in storage at Amptek. Both units contain power supply boards suitable for a standard 28V power bus. S/N 004 contains hardware and software for a MILSTD-1553B serial telemetry interface, while S/N 005 contains hardware and software for an RS422 serial telemetry interface. In the past year we have provided some support to AFRL/VSBS as they examine possible spacecraft opportunities. We are also in the process of writing a calibration report, an archival report to describe the calibration procedures and results. We will support spacecraft interfacing efforts when directed by the technical monitor.

¹ A summary of the first five years is found in AFRL-VS-TR-2001-1620, *Small On-Board Environmental Diagnostic Sensors Package (SOBEDS)*.